DOCUMENT RESUME

ED 107 215 IR 001 951

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TITLE Individual Differences in Learner Controlled CAI.
INSTITUTION Texas Univ., Austin. Computer-Assisted Instruction Lab.
SPONS AGENCY Air Force Human Resources Lab., Lowry AFB, Colo. Technical Training Div.; National Science Foundation, Washington, D.C. Office of Experimental Projects and Programs.
PUB DATE Apr 75
NOTE 14p.; Paper presented at the Annual Meeting of the American Educational Research Association (Washington, D.C., March 30 through April 3, 1975); For related documents see ED 094 732 and 733

EDRS PRICE MF-$0.76 HC-$1.58 PLUS POSTAGE
DESCRIPTORS *Anxiety; Autoinstructional Aids; College Students; *Computer Assisted Instruction; *Educational Research; Higher Education; *Learning Characteristics; Learning Processes; *Man Machine Systems
IDENTIFIERS Aptitude Treatment Interaction; *Learner Control

ABSTRACT

Two assumptions in support of learner-controlled computer-assisted instruction (CAI) are that (1) instruction administered under learner control will be less aversive than if administered under program control, and (2) the student is sufficiently aware of his learning state to make, in most instances, his own instructional decisions. Some 130 college student subjects were exposed to a CAI module on 12 edible plants native to Texas. The program for one group included pictures of the plants to help in their identification. A second group was never shown the pictures, and the third group had the option of choosing whether or not they wanted to see the pictures. It was anticipated that those subjects having an option would almost always elect to see the pictures. To provide for investigating individual differences in the use of learner control, a second, less appealing option was introduced--a review of the plants' critical features. It was concluded that learner control over a facilitating treatment did not reduce state of anxiety; the student's ability to use learner control effectively appeared to be a function of personality traits as well as cognitive skills. This suggests that state of anxiety tends to be task specific, and that the relationship of tasks to anxiety should be explored in subsequent research. (Author/DGC)

Individual Differences in Learner Controlled CAI[1]

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Two of the assumptions on which advocacy of learner controlled computer-assisted instruction (CAI) has been based are that (1) instruction administered under learner control will be less aversive than if administered under program control, and (2) the student is sufficiently aware of his learning state to make, in most instances, his own instructional decisions. While earlier studies tended to support these assumptions, recent research, introducing greater control over the learning situation in general and over the learner control options in particular, has produced mixed results. The relevant literature may be characterized as promising but confused.

It is our contention that four major reasons for this confusion are (1) a lack of consensus as to the definition of "learner control"; (2) lack of attention to individual differences in the use of learner control; (3) the absence of evidence that

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[1]The research reported was supported by funding from the U.S. Air Force Human Resources Laboratory, Technical Training Division (Contract No. F41609-73-C-0032) and the National Science Foundation, Office of Experimental Projects and Programs, Education Directorate (Grant No. EC 509X).

the instructional variable(s) placed under learner control have an appreciable effect on learning; and (4) lack of specificity in measures of the presumed affective advantages of learner control.

An experiment reported by Collier, Poynor, O'Neil, and Judd (1973) employed an experimental design which sought to address the last two of these problems. Specifically, the design incorporated two control groups: The first (designated treatment present), always received an instructional treatment which was presumed to be generally facilitating for the experimental task--a series of difficult concept identification problems. The second (treatment absent) group never received the treatment. Access to the treatment was placed under learner control for a third group. Comparison of the performance of the two control groups confirmed that the treatment was indeed facilitating. As anticipated, the performance of the learner control subjects approximated that of the group always receiving the treatment. The dependent variable of interest was the hypothesized affective advantage of learner control, operationalized as reported state anxiety following each of the task's three problems. Spielberger (1966) has defined state anxiety as feelings of apprehension and dread which vary in intensity and fluctuate over time, accompanied by autonomic nervous system activity. Learner control subjects demonstrated a significantly lower mean state anxiety level than did either control group, thus supporting the hypothesis.

The objectives of the present experiment (Judd, O'Neil, & Spelt, 1974b) were to replicate the findings of Collier et al. (1973) in the context of a more extensive and realistic CAI task and to investigate the interaction of learner control with two types of individual difference measures: (1) a task specific ability measure; and (2) two measures of the general personality trait of independence. To fulfill the requirements of the experimental paradigm, it was again necessary that the instructional treatment be shown to be generally facilitating, that is, that the performance of subjects who always received the treatment (treatment present or TP) be significantly superior to the performance of subjects who never received the treatment (treatment absent or TA). Given that these conditions were met, it was hypothesized that the mean level of state anxiety reported by learner control (LC) subjects at the conclusion of the task would be significantly less than that reported by TP subjects.

It was further hypothesized that relatively independent subjects would tend to adjust their use of the learner control options as a function of the feedback they received about their performance in the program while the use of learner control by less independent subjects would be relatively insensitive to feedback.

Method

Subjects. Subjects were 130 University of Texas undergraduate student volunteers who were paid for their services.

The learning task was a tutorial CAI program on 12 edible plants native to Texas. Subjects learned to identify the name and critical identifying features of each plant. The materials were programmed for an IBM 1500 Instructional System and presented by means of a cathode-ray tube terminal and filmstrip projector. Subjects responded by means of a typewriter keyboard. Research using a previous version of this program (Judd, O'Neil, & Spelt, 1974a) suggested that photographs of the plants facilitated subjects' memory for the plants' critical features as well as their identification of the plants. Therefore, three pictures of each plant were shown to TP subjects. TA subjects were never shown the pictures during instruction and LC subjects were given the option of accessing the pictures for each plant.

It was anticipated that LC subjects would almost always opt to view the pictures and, thus, there would be little variability in the use of this option. To provide for investigating individual differences in the use of learner control, a second, less appealing option was introduced into the instruction for each plant--review of the plant's critical features. To maintain integrity of the design, these reviews were always presented to TP subjects and never presented to TA subjects.

Figure 1 presents a flowchart of the overall program structure. After a short tutorial on terminal use, subjects were instructed on four plants, tested on these four, instructed on eight more plants, given instruction on a general plant identification strategy as an intervening task, and, finally, tested over all 12 plants.

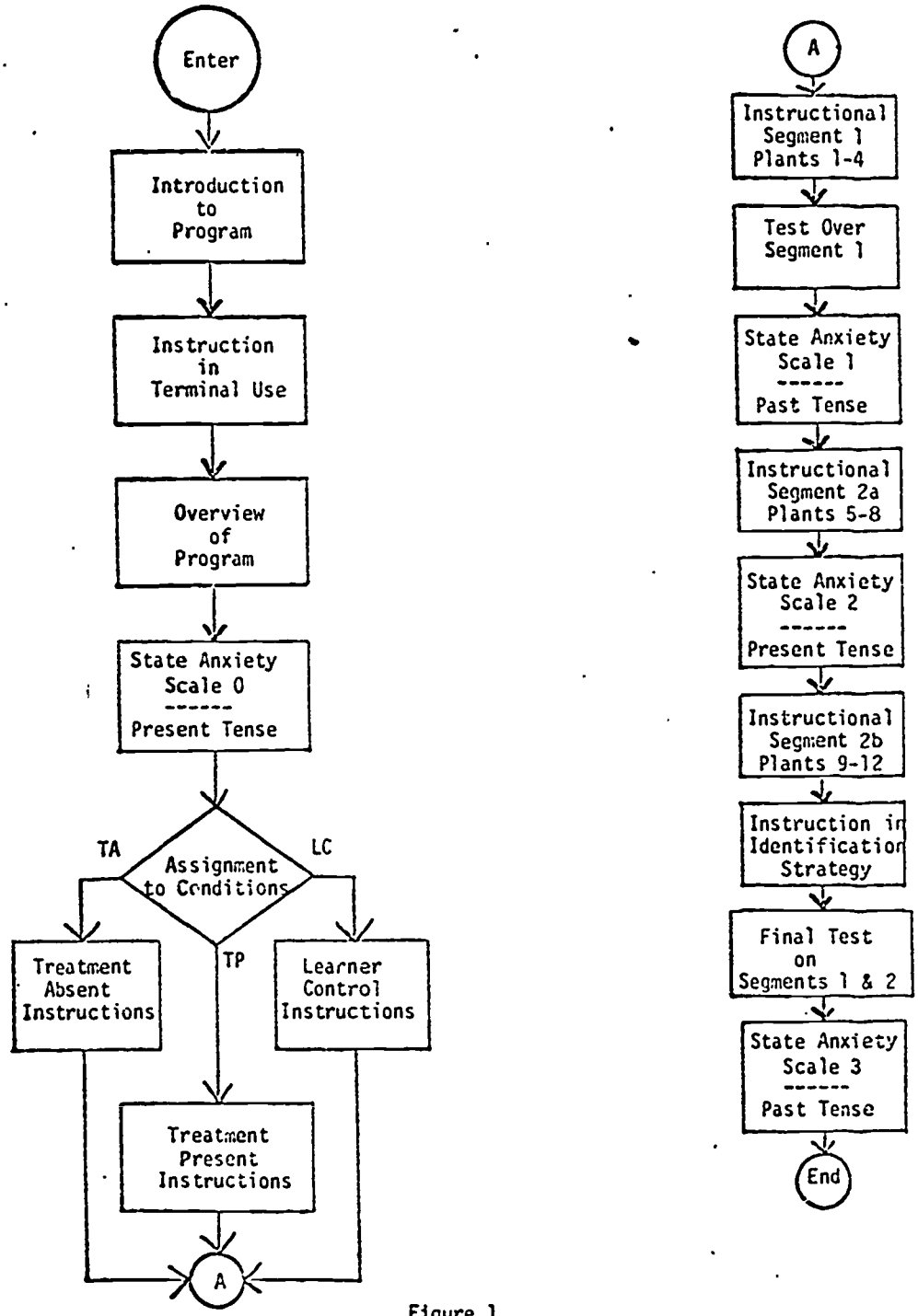

Figure 1
Overall Program Structure

Measurement scales. Since the experimental paradigm required that the facilitating treatment be generally facilitating, an independent measure administered prior to the task was required to predict individual differences in task performance. A task specific measure was developed which paralleled the most difficult component of the task--association of plants' critical features with their names. To establish construct validity, the MA-3 (associative memory) test from the French Kit (French, Ekstrom, & Price, 1963) was administered to all subjects and was found to correlate .46 with the task specific measure. Correlations of the task specific measure with errors on the critical features component of the final test were .38, .30, and .31 for TA, TP and LC subjects, respectively.

The construct of independence was measured by two scales administered prior to the task: Rotter's (1966) Internal/External Locus of Control (IE) measure; and the Achievement via Independence (Ai) scale of the California Psychological Inventory (Gough, 1957).

State anxiety was measured by the short, five-item form of the State Anxiety Scale from the State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970). As shown in Figure 1, this scale was administered on-line at four points in the program: following the program overview; following the first test; following

instruction on four of the eight plants in the second segment; and following the final test. Only the fourth administration was considered to be relevant to the hypothesis.

Results

Paradigm validation. The plant photographs were found to be generally facilitating. The results are summarized in Figure 2. With error score on the task specific memory measure used as a covariable, it was found that TA subjects committed significantly more errors on both the critical features ($p = .007$) and identification ($p = .001$) components of the final test. LC subjects almost always elected to view the plant photographs. The mean request rate was .98. The performance of the LC subjects was significantly superior to that of TA subjects ($p = .01$ for critical features and $p = .004$ for identification) and did not differ significantly from the performance of TP subjects.

State anxiety. Given that the paradigm requirements were met, the assumption of an affective advantage for learner control *per se* leads to the expectation that the mean state anxiety level reported by LC subjects following the final test would be significantly less than that reported by TP subjects. This was not found to be the case. With score on the pre-experimental anxiety measure used as a covariable, state anxiety level of LC subjects was found to be

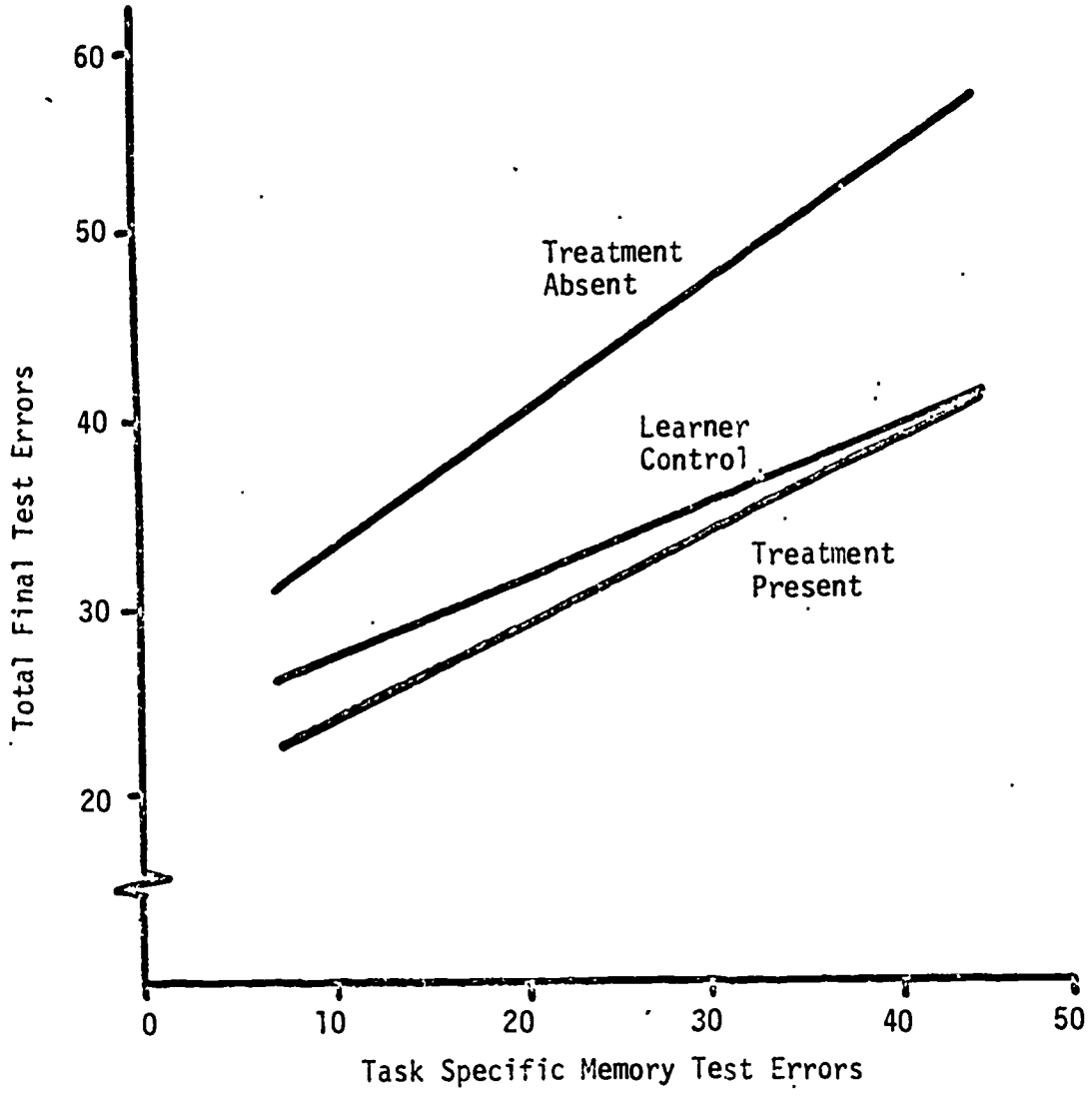

Figure 2: Total Number of Errors on the Final Test for each of three Experimental Groups as a Function of Error Scores on the Task Specific Memory Test.

slightly (not significantly) greater than that of TP subjects on the scales administered following both of the two tests. There was a slight but nonsignificant advantage for LC on the scale embedded in the second instructional segment. As an indication of the fact that the anxiety measure was sensitive to task characteristics, the reported anxiety level of TA subjects was found to be significantly ($p = .027$) higher than that of TP subjects following the final test.

Subject independence. For each of the two measures of independence, the 66 LC subjects were classified as being either relatively independent (internally controlled, high Ai) or dependent (externally controlled, low Ai) on the basis of a median split on the scores of all 130 subjects. To determine the extent to which LC subjects adjusted the frequency of their requests for critical features review as a function of performance feedback, a percentage score was computed for each subject representing the amount by which he increased or reduced his use of the option from the first to the second instructional segment. The number of first test errors was then used as a covariable. Support for the hypothesis that the learner control behavior of independent subjects would be more sensitive to performance feedback required a significant interaction between the covariable and classification as independent or dependent. Specifically, it was hypothesized that the percentage change score would be positively related to the covariable for the relatively independent subjects.

No interaction was found when subjects were classified on the basis of IE, but a significant ($p = .047$) interaction was found between Ai score category and number of first test errors. This interaction is illustrated in Figure 3. High Ai subjects who performed well on the first test substantially reduced the frequency of their review requests while high Ai subjects who performed poorly on the test maintained or increased the frequency of their requests. Low Ai subjects, on the other hand, tended to reduce the frequency of their requests regardless of first test performance.

Conclusions

Under the conditions of this experiment, it must be concluded that learner control over a facilitating treatment did not reduce state anxiety. Failure to replicate the results reported by Collier et al. could be attributed to a number of the dimensions along which the two experiments differed. Collier's task involved concept identification as opposed to the paired-associate nature of the present task and appeared to be much more difficult. Whereas Collier's task involved sterile, abstract concepts, the material taught in the present task was intrinsically interesting. The major difference might well be the fact that the current task was designed to be effective instruction while Collier employed a typical laboratory task.

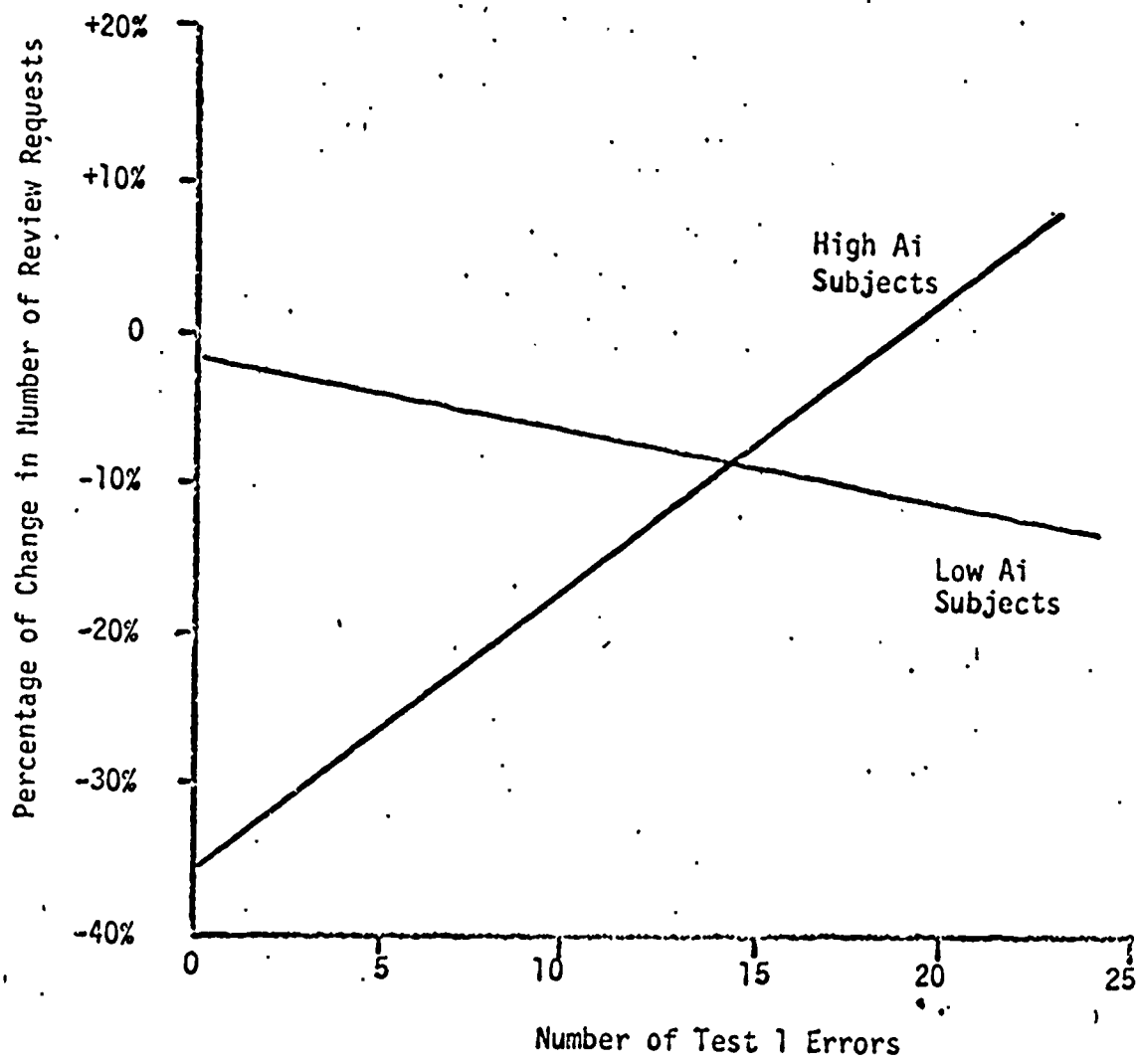

Figure 3: Percentage of change in Learner Control Review Requests from the First to the Second Instructional segment for High (Ai $\geq$ 19) and Low (Ai $\leq$ 18) Achievement Oriented subjects as a function of Test 1 errors.

Although the results were not as pronounced as could be desired, the capability of the Achievement via Independence scale to predict differences in learner control behavior is quite suggestive. The relationship detected was not simple. It was a complex function involving the subjects' perceptions of their prior performance as well as a general personality trait.

The results suggest a number of implications for learner controlled instruction, whether computer based or not. Students' ability to use learner control effectively appears to be a function of personality traits as well as cognitive skills. It is anticipated that more specific measures could be developed to more accurately define these characteristics. At least one aspect of the presumed affective advantage of learner control, state anxiety, appears to be task specific and future research should be directed at determining the characteristics of those tasks for which learner control is appropriate.

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